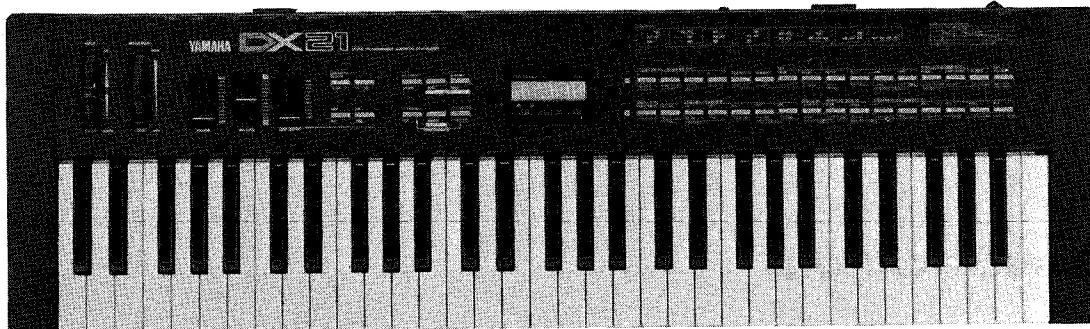


# DIGITAL PROGRAMMABLE ALGORITHM SYNTHESIZER

# DX21

## SERVICE MANUAL



DX21

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**YAMAHA**

NIPPON GAKKI CO., LTD. HAMAMATSU, JAPAN

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## IMPORTANT NOTICE

This manual has been provided for the use of authorized Yamaha Retailers and their service personnel. It has been assumed that basic service procedures inherent to the industry, and more specifically Yamaha Products, are already known and understood by the users, and have therefore not been restated.

**WARNING:** Failure to follow appropriate service and safety procedures when servicing this product may result in personal injury, destruction of expensive components and failure of the product to perform as specified. For these reasons, we advise all Yamaha product owners that all service required should be performed by an authorized Yamaha Retailer or the appointed service representative.

**IMPORTANT:** The presentation or sale of this manual to any individual or firm does not constitute authorization, certification, recognition of any applicable technical capabilities, or establish a principle-agent relationship of any form.

The data provided is believed to be accurate and applicable to the unit(s) indicated on the cover. The research, engineering, and service departments of Yamaha are continually striving to improve Yamaha products. Modifications are, therefore, inevitable and changes in specification are subject to change without notice or obligation to retrofit. Should any discrepancy appear to exist, please contact the distributor's Service Division.

**WARNING:** Static discharges can destroy expensive components. Discharge any static electricity your body may have accumulated by grounding yourself to the ground buss in the unit (heavy gauge black wires connect to this buss).

**IMPORTANT:** Turn the unit OFF during disassembly and parts replacement. Recheck all work before you apply power to the unit.

## ■ SPECIFICATIONS

**Keyboard** ..... 61 keys, C<sub>1</sub> ~ C<sub>6</sub>

**Sound Source** ..... FM Tone Generator: 4 operators × 2 (A,B), 8 Algorithms

**Simultaneous Note Output** ..... Polyphonic: 8 notes (SINGLE), 4 notes (DUAL), 4 + 4 notes (SPLIT)  
Monophonic: 1 note (SINGLE, DUAL), 1 + 1 note (SPLIT)

**Internal Memory** ..... 128 ROM voice memory  
32 RAM voice memory  
32 RAM performance memory

**Controls** ..... PITCH BEND WHEEL, MODULATION WHEEL, VOLUME, BALANCE, DATA ENTRY

**Display** ..... LCD (16 characters x 2 lines)

**Connecting Terminals** ..... OUTPUT MIX/A, OUTPUT B, PHONES, CASSETTE

**Control Terminals** ..... FOOTSWITCH (SUSTAIN, PORTAMENTO), FOOT CONTROLLER (VOLUME),  
MIDI (IN, OUT, THRU)

**Dimensions/Weight** ..... 909 (W) x 82 (H) x 270 (D) mm (35.8" x 3.2" x 10.6")  
8 kg (17.6 lbs)

**Power Requirements** ..... U.S. & Canadian Models: 120 V, 50/60 Hz  
General Models: 220 ~ 240 V, 50 Hz

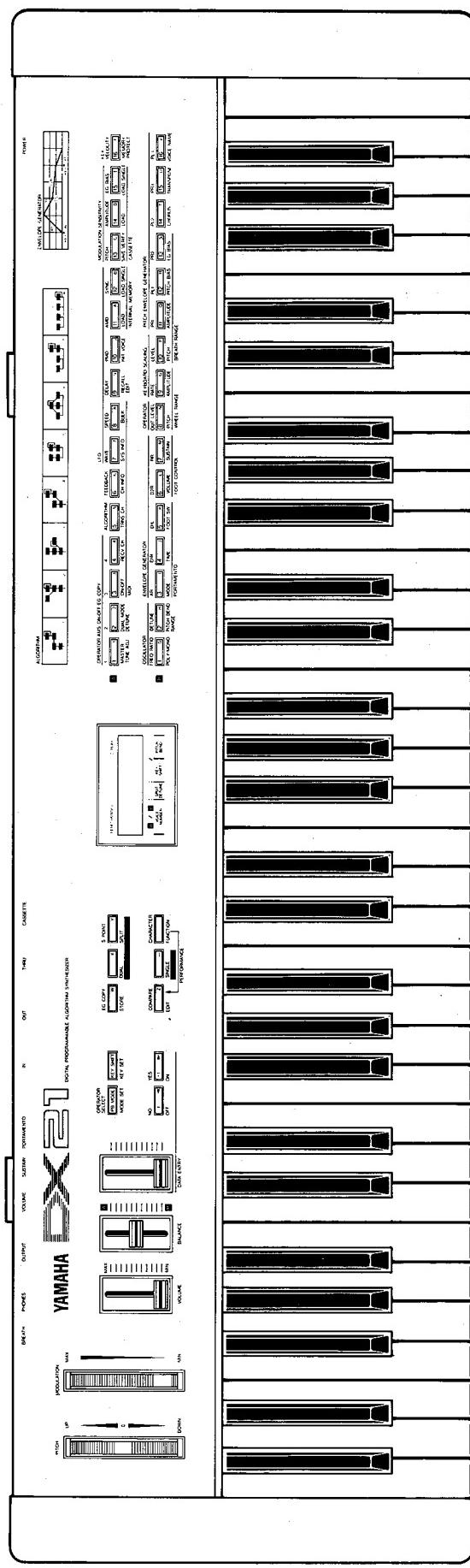
**Power Consumption** ..... 7 W

**Standard Accessories** ..... Music Stand, Cassette Cable

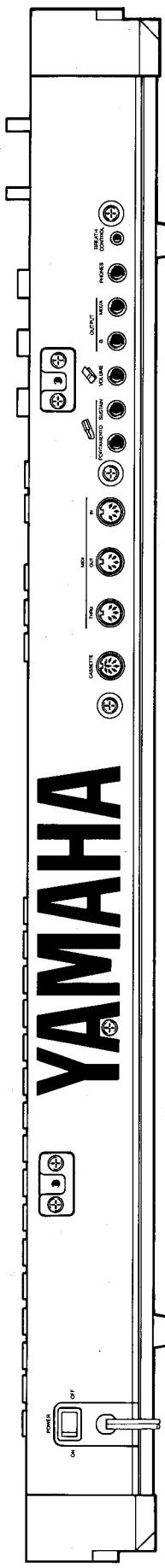
**Optional Accessories** ..... FC7 Foot Controller, FC4 or FC5 Footswitch, BC1 Breath Controller, LC-21S or SC-21 Carrying Case, LG-21 Stand, MIDI-03 or MIDI-15 MIDI Cable

## ■ PANEL LAYOUT

## ● Control Panel



## ● Bear Panel



## ■ TEST PROGRAMS

### NOTE:

When the test program is executed, data in the performance memory will be initialized. Please write down the data to the performance data table before executing the program.

BEFORE ENTERING THE TEST MODE OF THE DX21, IT IS RECOMMENDED THAT YOU READ THROUGH THE TEST PROGRAM PROCEDURES... TEST 2 REQUIRES THE CONNECTION OF EXTERNAL DEVICES AND IT MAY HELP TO MAKE THE CONNECTIONS AND ADJUSTMENTS OF THIS TEST PRIOR TO ENTERING THE TEST MODE.

### Test Mode Entry Procedure

To enter the internal test mode of the DX21, turn the power switch on while depressing the voice buttons **[1]** and **[2]** on the side A. Release buttons **[1]** and **[2]** once characters are displayed on the LCD. The unit will then display the ROM version message and automatically go to the first test or check.

### TEST 1: ROM version message and level check

After initiating the Test Mode, the unit displays the message shown below.

V1. 2	05-Mar-85
Check Level	

The first line of the LCD display indicates the ROM version number (V1. 2) and the date of that version. The second line of the display indicates that the unit is in the Level Verification Mode. Sine waves of 440Hz are output from each output jack when the volume is at its maximum level. The table shown below has the necessary information to check or verify each output level.

Output Jack	Level	Load
OUT A, B	-22dBm	10K
PHONES R, L	-13dBm	47

Before proceeding to the TEST 2, please read the instructions of that test. After reviewing the test procedure, depress the **[+1]** button to initiate the test.

### TEST 2: Check of RAM, MIDI I/O, and Cassette Interface

Before initiating this test make the following connections as indicated below:

1. Connect MIDI IN and OUT with a MIDI cable.
2. Connect the cassette OUT jack to the input of an amplifier and connect the output of the amplifier to the cassette IN jack.

### SPECIAL INSTRUCTIONS:

\*A mixer or stereo cassette deck can be used as this amplifier stage. This amplifier is essentially inserted in the cassette OUT and IN path. The mixer or stereo cassette deck (in the REC/PAUSE mode) must be adjusted to have a gain of approximately 10dB.

This gain adjustment should be made before entering the Test Mode. To make this gain adjustment access the CASSETTE SAVE function of the DX21 and initiate the SAVE function by depressing the **[+1]** button twice. The Voice information of the DX21 is then transmitted from the Cassette OUT jack and has an approximate level of -28dB. Therefore, connect a level meter to the output of the amplifier stage and adjust the output level to approximately -18dB (a 10dB gain). Now the amplifier gain is adjusted to perform the Cassette OUT/IN test.

When you initiate TEST 2 by depressing the **[+1]** button, this test automatically executes the RAM, MIDI I/O, and cassette OUT/IN interface checks. If no ERRORS are detected then the test routine automatically sequences to TEST 3, the LCD Test.

If the RAM is bad the LCD display will indicate which IC is bad, providing that the malfunctioning RAM IC does not cause a system operation problem. If there is a malfunction of the MIDI OUTPUT or INPUT, the LCD display indicates ERROR MIDI! Also, it should be noted that if the MIDI test was checked by another technician the correct MIDI data may already be stored in the MIDI BUFFER. Therefore, if you initiate the MIDI test with no MIDI cable plugged in it will still pass the test with no ERROR. You can CLEAR the MIDI buffer by connect the cable and play the keyboard in the normal operating mode. This procedure will store different MIDI data into the MIDI BUFFER.

If the cassette OUTPUT, INPUT or the inserted amplifier stage malfunctions, the LCD display will indicate ERROR CASS.!

### TEST 3: LCD Check

This test checks the LCD display. All dots on the LCD should flash. Verify that each dot flashes.

Before proceeding on to TEST 4, the A/D and footswitch test, connect the BC-1, FC-7, and two FC-4s to all BREATH, VOLUME, SUSTAIN, and PORTAMENTO jacks. Then depress **[+1]** for approximately one second to proceed to TEST 4.

**TEST 4: A/D and Footswitch check**

For this test you operate the controls as indicated by the LCD display. Once the control is operated throughout its range LCD display will indicate the next control that to be checked. If a control or controller is malfunctioning then the test will not advance to the next control. It should also be noted that all controls and controllers must be checked for the Test Routine continue on to the next test. This test checks the following controls and controllers listed below:

1. The PITCH BEND control
2. The MOD. WHEEL control
3. The DATA ENTRY control
4. The FOOT VOL. controller
5. The BREATH controller
6. The SUSTAIN footswitch
7. The PORTAMENTO footswitch

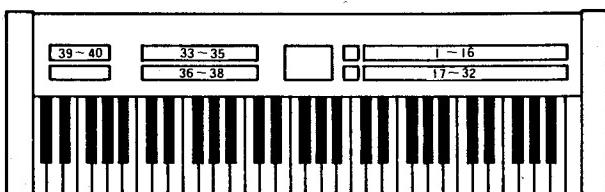
The test routine automatically increments to the TEST 5, once all checks have been completed.

**TEST 5: Keyboard check**

Test 5 checks the keyboard contacts. The LCD displays the keys to be depressed and once the key is depressed and released the LCD will indicate the next key to be depressed. No error message occurs when a key contact is bad or a key is depressed in error. Once all key contacts have been verified by depressing and releasing the appropriate keys, the Test Routine advances to TEST 6, the Panel Switch check.

**TEST 6: Panel Switch check**

For this test, press the switch indicated by the LCD display. The numbering order of the panel switch sequence is shown below.



After the panel switch test has been completed, the test routine automatically exits the Test Mode and the unit returns to its normal operating mode.

## ■ BASIC CIRCUIT OPERATIONS

### 1. The Main Clock Circuit

The clock generation circuit for the CPU and sound generation, generates a signal having a frequency of 7.15909MHz. The signal of 7.15090MHz is applied to the EXTAL pin of the CPU, and divided by a factor of 4 inside the CPU to create the system clock.

A signal having a frequency of 3.58MHz is used for sound generation.

### 2. The Sub-Clock Circuit

This clock circuit generates a signal of 500kHz for A/D conversion and the MIDI clock. The 500kHz clock signals are applied to pin 22 of the CPU, which in turn is divided by a factor of 16 inside the CPU to create the 31.25kHz MIDI clock.

### 3. The Reset Circuit

A reset signal is generated an RC network and Schmitt Trigger inverter IC. A reset IC is used to short any remaining voltage of the 10 microfarad charging capacitor to ground on power-up. Then the reset IC goes to a high impedance state to allow the capacitor to charge via a resistor connected to the +5V supply. Therefore, initially the reset signal is a logic "LOW" level until the capacitor reaches the threshold of the Schmitt Trigger Invertor ICs and then the reset signal switches to a "HIGH" logic level. The reset signal is also fed to two transistors. One transistor controls the Battery Back-Up circuit and the other control the CHIP SELECT 2 signal for the RAM ICs. The CHIP SELECT 2 or CE2 signals disables the RAM ICs so they will not be selected. This eliminates the possibility of the RAM ICs being accessed and accidentally written to.

### 4. The CPU, ROM and RAM

- The CPU with clock input of 7.15909MHz, operates with a system clock of approximately 1.8MHz. The access time for the ROM, RAM, and other components connected to the bus must be faster as the read/write pulse width is approximately 260nS.
- The ROM is allocated from addresses \$8000 to \$FFFF of the memory, with \$8000 to \$A480 being the area for the 128 voice data, and \$A480 to \$FFFD being the program area. The use of two 128K bytes ROM is possible. In this case, jumper \*1 is moved to \*2, and IC36 is installed.
- The RAM is allocated from addresses \$1000 to \$27FF of the memory with the area from \$1000 to \$191F used as the voice memory area, and the area from \$1920 and above is used for the various stacks and registers. Furthermore, the entire area is memory backed up by a battery to enable the memory to be retained after the power is turned off.

### 5. The Address Map

The CPU addresses are as follows:

\$00 ~ \$1F	Internal CPU registers and ports
\$20	A/D output port
\$22	A/D start
\$24	OPM
\$26	LCD
\$28, \$29	CHORUS ON-OFF
\$40 ~ \$FF	RAM in CPU
\$1000 ~ \$27EF	RAM
\$8000 ~ \$FFFF	ROM

### 6. The A/D Circuit

The A/D circuit uses an 8 bit 8 channel ADC IC. Five of the eight input channels are used. When a channel number and start pulse are received from CPU, conversion is performed for that channel. The CPU is notified of the completed conversion when it receives the EOC signal from the ADC IC. The CPU outputs the OE signal after detection of EOC, and data is fetched from the data bus.

### 7. The Sound Generation Circuit

This circuit consists of 4 function operator with 8 note capability. The FM tone generator or operator and the DAC, generate the FM tones based on data from the CPU. There are two channels for audio output, and different voices are possible on each channel.

### 8. The Chorus Circuit

This is a phase modulation circuit with a 128 stage BBD. The effect is turned on/off by the CPU.

### 9. The HP Circuit

This is an amplification circuit for the headphones which allows use of headphones having an impedance of 8 to 150 ohms.

### 10. The Switch Scan Circuit

The switch scan circuit is connected directly to the CPU and is capable of scanning 128 (8 x 16) switches. With the DX21, 61 Keyboard switches and 42 panel switches are scanned, for a total of 103 switches.

### 11. The MIDI circuit

The MIDI circuit is connected directly to the CPU and has IN, OUT, and THRU OUT terminals, and meets MIDI standards V1.0.

### 12. The Cassette Interface Circuit

The cassette interface circuit connected is also directly to the CPU and runs the cassette I/O at a rate of 1200 baud which is controlled by the CPU software.

## ■ TABLE OF IC PIN FUNCTIONS

### YM2164 OPP

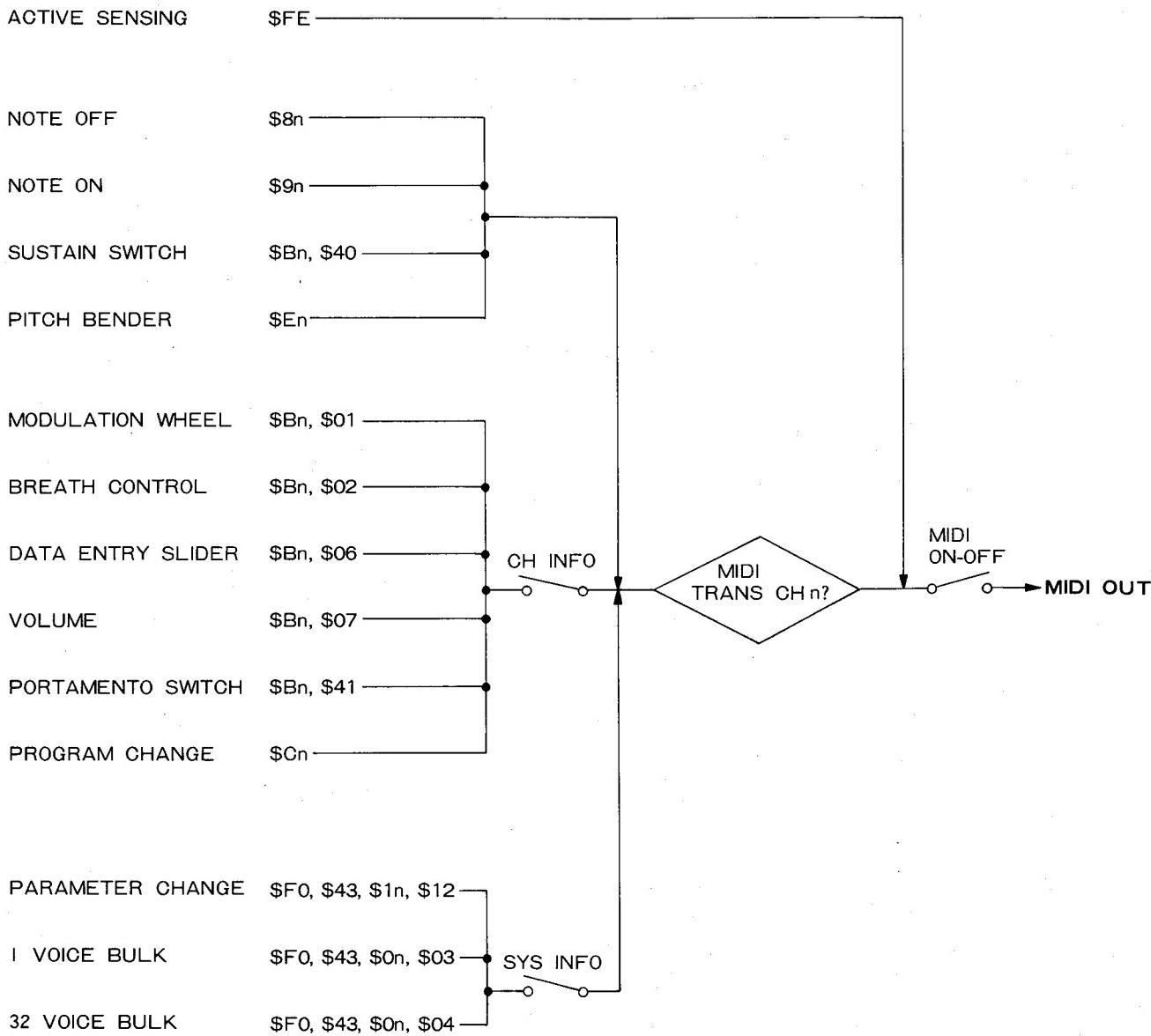
Pin No.	Pin Name	I/O	Function	Remarks
1	Vss	-	GND	
2	IRQ	-	IRQ output port	
3	IC	I	"L" reset input (Active Low)	
4	A <sub>0</sub>	I	Internal register selection signal input	
5	WT	I	Data write request input from CPU	
6	RD	I	Data read request input from CPU	
7	CS	I	Chip selection input	
8	CT1	O	Filter characteristics switch or control signal output for voice synthesizing	
9	CT2	O	"	
10	D <sub>0</sub>	I/O	3-state data bus I/O port	
11	Vss	-	GND	
12	D <sub>1</sub>	I/O	3-state data I/O port	
13	⋮	I/O		
18	D <sub>7</sub>	I/O	Signal output for L/R separation	
19	SH2	O		
20	SH1	O	Sound generation serial data (L/R)	
21	S <sub>0</sub>	O		
22	Vcc	-	Power +5V	
23	φI	O	Clock output for DAC synchronization	
24	φM	I	CPU master clock input for synchronization with CPU	

### YM3012 DAC

Pin No.	Pin Name	I/O	Function	Remarks
1	Vcc	-	+5V	
2	CLOCK	I	Timing clock input for synchronization with OPP	
3	GND	-	Digital GND	
4	DATA	I	Voice serial data input	
5	SAM 1	I	Data input for sampling (for L/R separation)	
6	SAM 2	I	" ( " )	
7	ICL	I	Initial clear input	
8	GND	-	Analog GND	
9	CH 1	O	CH1 (L ch) analog signal output	
10	CH 2	O	CH2 (R ch) "	
11	COM	I	L/R Separation input	
12	To BUF	O	DAC Analog output	
13	Mid. Point	I	Reference voltage input of analog signal	
14	BC	O	Bias compensation	
15	RB	O	1/2 Vcc bias regulator output	
16	GND	-		

## **MIDI DATA FORMAT**

## **1. Transmission Conditions**



## **2. Transmission Data**

All MIDI data is transmitted when the MIDI ON/OFF function is ON. The MIDI transmission channel is determined by the setting of the MIDI TRNS CH function.

## **2-1. CHANNEL INFORMATION**

### **2-1-1. Channel Voice Message**

**(1) Key Off**

Status	1000nnnn	n=channel no.
Note no.	0kkkkkkk	k=36(C1) ~ 96(C6)
Velocity	01000000	

**(2) Key On**

Status	1000nnnn	n=channel no.
Note no.	0kkkkkkk	k=36(C1) ~ 96(C6)
Velocity	01000000	

**(3) Control Change**

Status	1011nnnn	n=channel no.
Control no.	0ccccccc	
Control code	0vvvvvvv	

- a) Transmitted whether MIDI CH INFO is ON or OFF

Control no.	Control code.
C=64: Sustain sw.	V=0:OFF, 127:ON

- b) Transmitted when MIDI CH INFO is ON

Control No.	Control code
C=1: modulation wheel	V=0~127
C=2: breath control	V=0~127
C=6: data entry slider	V=0~127
C=7: foot volume	V=0~127
C=65: portamento sw.	V=0:OFF, 127:ON

**(4) Program Change**

Status	1100nnnn	n=channel no.
Program no.	0ppppppp	p=0~31

This data is transmitted when a voice selector is pressed during the play mode, when MIDI CH INFO is ON and MIDI SYS INFO is OFF. Also transmitted when a performance selector is pressed in the performance mode.

**(5) Pitch Bend**

Status	1110nnnn	n=channel no.
Code (LSB)	0uuuuuuu	
Code (MSB)	0vvvvvvv	

The transmitted data is as follows:

MSB	LSB	
00000000	00000000	Lowest value
01000000	00000000	Center value
01111111	01111110	Highest value

**2-2. SYSTEM INFORMATION****2-2-1. System Real-time Message**

Active sensing		
Status	11111110	

Transmitted once approximately every 200 milliseconds

**2-2-2. System Exclusive Message**

Trasnmitted only when MIDI SYS INFO is ON

**(1) Parameter Change**

Status	11110000
ID no.	01000011
Substatus/ch. no.	0001nnnn
Parameter group no.	00010010
Parameter no.	0ppppppp
Data	0ddddddd
EOX	11110111

This data is transmitted when voice or function parameters are changed in the EDIT or FUNCTION modes. The voice parameters transmitted are those given in voice parameter table 5-2, and the function parameters transmitted are shown in function parameter table 5-3.

**(2) 1 Voice Bulk Data**

Status	11110000
ID no.	01000011
Substatus/ch. no.	0000nnnn
Format no.	00000011
Byte count	00000000
Byte count	01011101
Data	0ddddddd
	{ 93 bytes
Checksum	0eeeeeee
EOX	11110111

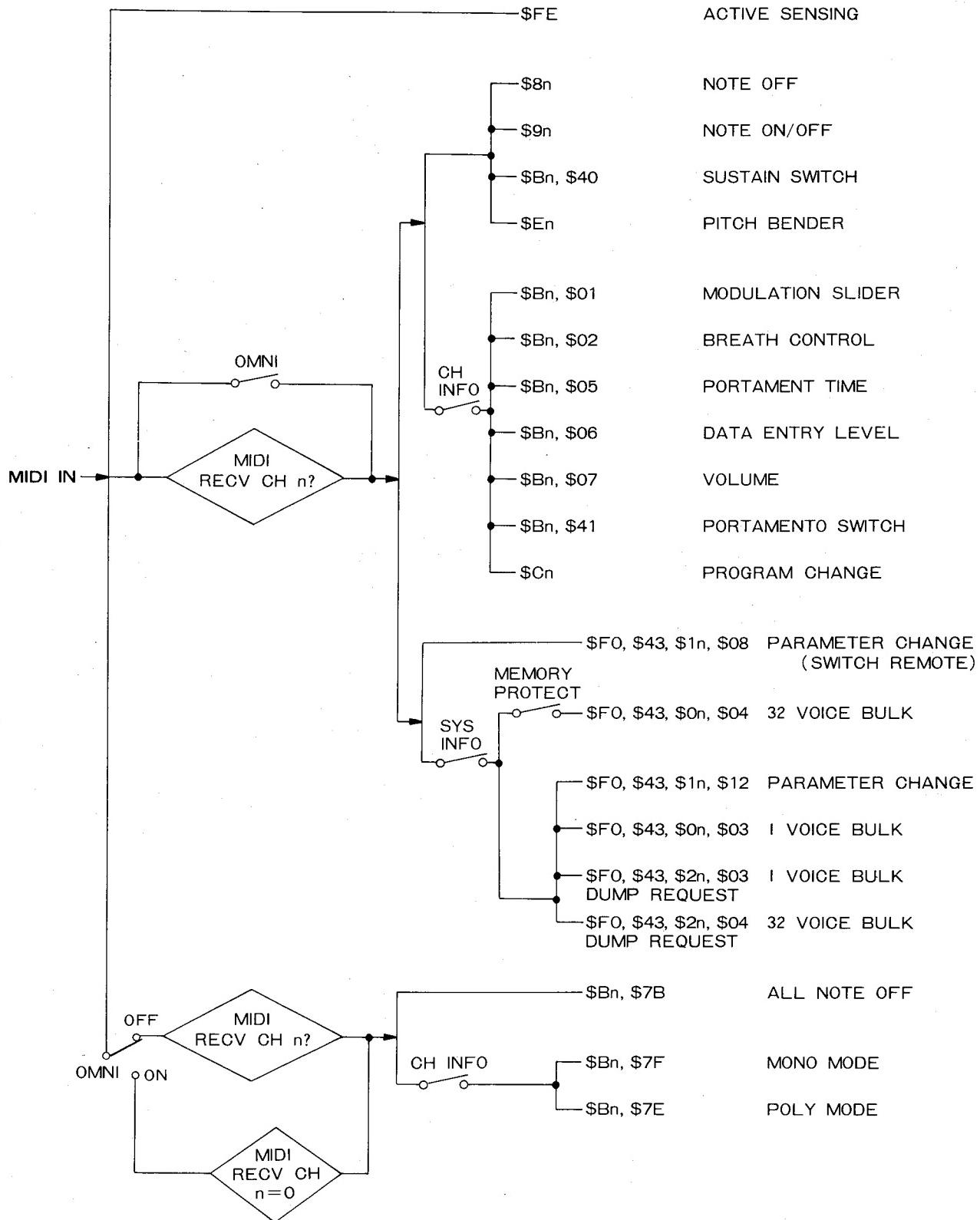
The data for one voice is transmitted when a voice selector is pressed in the PLAY SINGLE mode. Data in the voice edit buffer is transmitted when a format no. f=3 dump request is received. The transmitted data is shown in voice parameter table 5-2. The checksum is the lowest 7 bits of the two's complement sum of all data bytes (the same applies below).

**(3) 32 Voice Bulk Data**

Status	11110000
ID no.	01000011
Substatus/ch. no.	0000nnnn
Format no.	00000100
Byte count	00100000
Byte count	00000000
Data	0ddddddd
	{ 4096 bytes
Checksum	0eeeeeee
EOX	11110111

The data of all 32 voices in RAM memory will be transmitted if the YES (or BULK) key is pressed in response to the "MIDI Transmit?" display which appears when the BULK key is pressed in the FUNCTION mode. The data for all 32 voices will also be transmitted when a format no. f=4 dump request is received. The transmitted data is shown in voice data table 5-1. 55 bytes of 0's are added to the 73 bytes in this table, so 128 bytes are transmitted for each voice. 4096 bytes are therefore transmitted for all 32 voices.

### 3. Reception Conditions



## 4. Reception Data

All MIDI data is received when the MIDI ON/OFF function is ON. When a specific MIDI receive channel has been selected using the MIDI RECV CH function, and the OMNI mode is OFF, MIDI data will be received only on the specified channel. MIDI data will be received on all channels when the OMNI mode is ON.

### 4-1. CHANNEL INFORMATION

#### 4-1-1. Channel Voice Message

##### (1) Key off

Status	1000nnnn	n=channel no.
Note no.	0kkkkkkk	k=0(C-2) ~ 127 (G8)
Velocity	0vvvvvvv	v is ignored

##### (2) Key On/Off

Status	1001nnnn	n=channel no.
Note no.	0kkkkkkk	k=0(C-2) ~ 127(G8)
Velocity	0vvvvvvv	v=0: key off v=1~127: key on

The key on note level will vary according to the received velocity value. The range of this instrument is C-1 to B6. If a higher or lower key number is received, it will be output within the range limits. For example, received C7 through B7 data will be output as notes in the C6 through B6 range.

##### (3) Control Change

Status	1011nnnn	n=channel no.
Control no.	0ccccccc	
Control code	0vvvvvvv	

###### a) Received whether MIDI CH INFO is ON or OFF

Control no.	Control code
C=64: Sustain sw.	V=0:OFF, 127:ON
Control no.	Control code
C=1: modulation wheel	V=0~127
C=2: breath control	V=0~127
C=5: portamento time	V=0~127
C=6: data entry slider	V=0~127
C=7: foot volume	V=0~127
C=65: portamento sw.	V=0:OFF, 127:ON

##### (4) Program Change

Status	1100nnnn	n=channel no.
Program no.	0ppppppp	

Received only when MIDI CH INFO is ON. If received during the PLAY or PERFORMANCE mode the voice or performance number will be changed accordingly. The lower five bits of the program no. contain the voice or performance number.

##### (5) Pitch Bend

Status	1110nnnn	n=channel no.
Code (LSB)	0uuuuuuu	
Code (MSB)	0vvvvvvv	

Function s only on MSB data:

MSB	
00000000	Lowest value
01000000	Center value
01111111	Highest value

#### 4-1-2. Channel Mode Message

Status	1011nnnn	n=channel no.
	0ccccccc	
	0vvvvvvv	

- a) Recived whether MIDI CH INFO is ON or OFF

C=123 V=0 All notes OFF

- b) Received only when MIDI CH INFO is ON

C=126	V=1	MONO mode ON
C=127	V=0	POLY mode ON

## 4-2. SYSTEM INFORMATION

#### 4-2-1. System Real-Time Message

Active sensing

Status	11111110
--------	----------

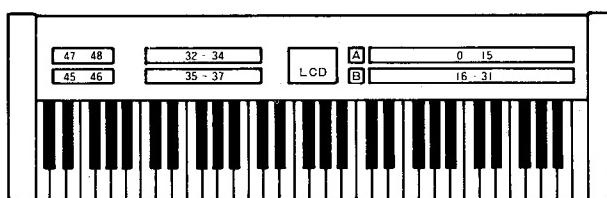
Sensing begins when this code is received once. If status and data are not received within 300 milliseconds the MIDI receive buffer will be cleared and the currently output note will be turned OFF.

#### 4-2-2. System Exclusive Message

##### (1) parameter Change (switch mode)

Status	11110000	
ID no.	01000011	
Substatus/ch. no.	0001nnnn	n=channel no.
Parameter group no.	00001000	
Switch no.	0mmmmmmm	
Data	0ddddddd	d=0:OFF, 1~127:ON
EOX	11110111	

All panel switches are controlled. The switch numbers are arranged as shown in the illustration below. Receiced only when MIDI SYS INFO is ON.



**(2) Parameter Change**

The format is the same as the transmitted parameter change data. Received only when MIDI SYS INFO is ON. Permits changing voice and function parameters while the EDIT mode is active. It is also possible to change modes: PLAY, EDIT, etc. The parameter no. and data received are shown in voice parameter table 5-2 and function parameter table 5-3.

**(3) 1 Voice Bulk Data**

Received only when MIDI SYS INFO is ON. The format is the same as for the transmitted 1 voice bulk data. The 93 voice data bytes are read into the voice edit buffer, replacing the current voice data. The 93 received data bytes are shown in voice parameter table 5-2.

**(4) 32 Voice Bulk Data**

Received only when MIDI SYS INFO is ON. The format is the same as for the transmitted 32 voice bulk data. This data can be received only when the MEMOTY PROTECT function is OFF. The received voice data is stored in the 32 RAM voice memory locations. The "MIDI RECEIVED!!" display appears to confirm complete reception of 32 voice bulk data.

**(5) Dump Request**

Status	11110000	
ID no.	01000011	
Substatus/ch. no.	0010nnnn	n=channel no.
Format no.	0fffffff	f=3,4
EOX	11110111	

Received only when MIDI SYS INFO is ON. When received the bulk data corresponding to the received format code will be dumped via MIDI OUT.

- f=3: 1 voice bulk data
- f=4: 32 voice bulk data

## 5. System Exclusive Data

### 5-1. VOICE DATA (VMEM format)

Parameter no. P	Parameter
0	ATTACK RATE
1	DECAY 1 RATE
2	DECAY 2 RATE
3	RELEASE RATE
4	DECAY 1 LEVEL
5	KEYBOARD SCALING LEVEL
6	AMPLITUDE MODULATION ENABLE/EG BIAS
7	SENSITIVITY/KEY VELOCITY
8	OUTPUT LEVEL
9	OSCILLATOR FREQUENCY
	KEYBOARD SCALING RATE/DETUNE 1
10	SAME AS FOR OP4
11	OP 2
19	
20	SAME AS FOR OP4
21	OP 3
29	
30	SAME AS FOR OP4
31	OP 1
39	
40	LFO SYNC/FEEDBACK LEVEL/ALGORITHM
41	LFO SPEED
42	LFO DELAY
43	PITCH MODULATION DEPTH
44	AMPLITUDE MODULATION DEPTH
45	PITCH MODULATION SENSITIVITY/AMPLITUDE
46	MODULATION SENSITIVITY/LFO WAVE
47	TRANSPOSE
48	PITCH BEND RANGE
	CHORUS SWITCH/PLAY MODE/SUSTAIN FOOT
	SWITCH/PORTAMENTO FOOT SWITH/PORTAMENTO
	MODE
49	PORTAMENTO TIME
50	FOOT VOLUME
51	MODULATION WHEEL PITCH MODULATION RANGE
52	MODULATION WHEEL AMPLITUDE MODULATION RANGE
53	BREATH CONTROL PITCH MODULATION RANGE
54	BREATH CONTROL AMPLITUDE MODULATION RANGE
55	BREATH CONTROL PITCH BIAS RANGE
56	BREATH CONTROL EG BIAS RANGE
57	VOICE NAME 1
66	VOICE NAME 10
67	PITCH EG RATE 1
68	PITCH EG RATE 2
69	PITCH EG RATE 3
70	PITCH EG LEVEL 1
71	PITCH EG LEVEL 2
72	PITCH EG LEVEL 3

## 5-2. VOICE PARAMETERS (VCED format)

Parameter no. P	Parameter	LCD Display	Data	Note
0	ATTACK RATE	EG AR	0 ~ 31	
1	DECAY 1 RATE	EG DIR	0 ~ 31	
2	DECAY 2 RATE	EG D2R	0 ~ 31	
3	RELEASE RATE	EG RR	0 ~ 15	
4	DECAY 1 LEVEL	EG DIL	0 ~ 15	
5	KEYBOARD SCALING LEVEL	LEVEL SCALE	0 ~ 99	
6	KEYBOARD SCALING RATE	RATE SCALE	0 ~ 3	
7	EG BIAS SENSITIVITY	E BIAS SENS.	0 ~ 7	
8	AMPLITUDE MODULATION ENABLE	A MOD SENS.	0, 1	
9	KEY VELOCITY	KEY VELOCITY	0 ~ 7	
10	OUTPUT LEVEL	OUTPUT LEVEL	0 ~ 99	
11	OSCILLATOR FREQUENCY	FREQUENCY	0 ~ 63	
12	DETUNE 1	DETUNE	0 ~ 7	
13	SAME AS FOR OP4	OP2		
25				
26	SAME AS FOR OP4	OP3		
38				
39	SAME AS FOR OP4	OP1		
51				
52	ALGORITHM	ALGORITHM SELECT	0 ~ 7	
53	FEEDBACK LEVEL	FEEDBACK	0 ~ 7	
54	LFO SPEED	LFO SPEED	0 ~ 99	
55	LFO DELAY	LFO DELAY	0 ~ 99	
56	PITCH MODULATION DEPTH	LFO PMD	0 ~ 99	
57	AMPLITUDE MODULATION DEPTH	LFO AMD	0 ~ 99	
58	LFO SYNC	LFO SYNC	0, 1	
59	LFO WAVE	LFO WAVE	0 ~ 3	
60	PITCH MODULATION SENSITIVITY	P MOD SENS.	0 ~ 7	
61	AMPLITUDE MODULATION SENSITIVITY	A MOD SENS.	0 ~ 7	
62	TRANSPOSE	Middle C	0 ~ 48	
63	PLAY MODE POLY/MONO	Poly Mode	0, 1	
64	PITCH BEND RANGE	P Bend Range	0 ~ 12	
65	PORTAMENTO MODE	Full Time Porta	0, 1	
66	PORTAMENTO TIME	Porta Time	0 ~ 99	
67	FOOT VOLUME	Foot Volume	0 ~ 99	
68	SUSTAIN FOOT SWITCH	Foot Sustain	0, 1	
69	PORTAMENTO FOOT SWITCH	Foot Porta	0, 1	
70	CHORUS SWITCH	Chorus	0, 1	
71	MODULATION WHEEL PITCH MODULATION RANGE	MW Pitch	0 ~ 99	
72	MODULATION WHEEL AMPLITUDE MODULATION RANGE	MW Amplitude	0 ~ 99	
73	BREATH CONTROL PITCH MODULATION RANGE	BC Pitch	0 ~ 99	
74	BREATH CONTROL AMPLITUDE MODULATION RANGE	BC Amplitude	0 ~ 99	
75	BREATH CONTROL PITCH BIAS RANGE	BC Pitch Bias	0 ~ 99	
76	BREATH CONTROL EG BIAS RANGE	BC EG Bias	0 ~ 99	
77	VOICE NAME	I ASCII		
86				
87	PITCH EG RATE 1	PEG RATE 1	0 ~ 99	
88	PITCH EG RATE 2	PEG RATE 2	0 ~ 99	
89	PITCH EG RATE 3	PEG RATE 3	0 ~ 99	
90	PITCH EG LEVEL 1	LEVEL 1	0 ~ 99	
91	PITCH EG LEVEL 2	LEVEL 2	0 ~ 99	
92	PITCH EG LEVEL 3	LEVEL 3	0 ~ 99	

### 5-3. FUNCTION PARAMETERS

Parameter no. P	Parameter	LCD Display	Data	Note
93	OPERATOR ENABLE/DISABLE		0 ~ 15	
94	OPETATOR SELECT		0 ~ 3	
95	EDIT MODE I=ON		0 , 1	*
96	FUNCTION MODE I=ON	FUNCTION CONTROL	0 , 1	*
97	STORE MODE I=ON	MEMORY STORE	0 , 1	*
98	PLAY DUAL MODE I=ON		0 , 1	*
99	PLAY SPLIT MODE I=ON		0 , 1	*
100	PLAY SINGLE MODE I=ON	PLAY SINGLE	0 , 1	*
101	DUAL MODE DETUNE	Dual Detune	0 ~ 99	
102	SPLIT POINT		0 ~ 127	*
103	MASTER TUNE \$40=CENTER	Master Tune	0 ~ 127	*
104	MIDI SWITCH I=ON	Midi Switch	0 , 1	*
105	MIDI CH INFO	Midi is OFF!	0 , 1	*
106	OMNI 0=OFF I=ON	Midi Omni	0 , 1	*
107	MIDI TRANS CH	Midi Trns Ch	0 ~ 15	*
108	MIDI RECV CH 0=OMNI ON	Midi Recv Ch	0 ~ 16	*
109	MIDI SYS INFO	Midi Sy Info	0 , 1	*
110	32 VOICE BULK DUMP	Midi Transmit?	1	*
111	EDIT RECALL	Recall Edit?	0 , 1	*
112	INIT VOICE	Init. Voice?	0 , 1	*
113				
114				
115				
116				
117				
118				
119	MEMORY PROTECT I=ON	Mem Protect	0 , 1	*
120	KEY SHIFT 24=CENTER	Key Shift	0 ~ 48	
121	PITCH BEND MODE I=ON	Bend Mode	0 , 1	*
122	KEY SHIFT		0 , 1	*
123	COMPARE		0 , 1	*
124	PITCH BEND MODE		0 ~ 2	
125				
126				
127				

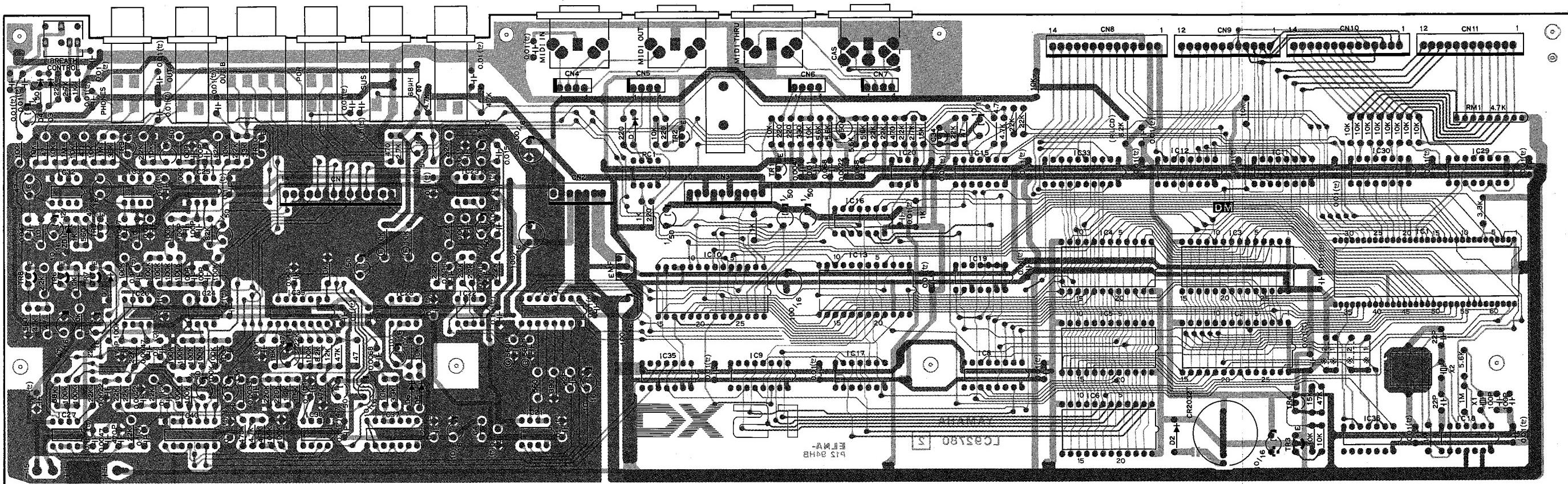
\*Receive only

[ Digital Programmable Algorithm Synthesizer ] Date : 3/9, 1985  
 Model DX21 MIDI Implementation Chart Version : 1.2

		Transmitted	Recognized	Remarks
	Function ...			
:Basic Channel	Default Changed	: 1 - 16	: 1 - 16	: memorized
:Mode	Default Messages Altered	: 3 x XXXXXXXXXXXXXXXX	: 1, 2, 3, 4 POLY, MONO(M=1) x	: memorized
:Note Number	: True voice	: 36 - 96 XXXXXXXXXXXXXXXX	: 0 - 127 0 - 127	
:Velocity	Note ON Note OFF	: x 9nH, v=64 x 8nH, v=64	: o v=1-127 x	
:After Touch	Key's Ch's	: x x	: x x	
:Pitch Bender		: o	: o 0-12 semi	: 7 bit resolution
:Control Change		1 : o 2 : o 5 : x 6 : o 7 : o 64 : o 65 : o 96 : o 97 : o	X1 : o X1 : o : o X1 : x X1 : o : o X1 : o	X1 : Modulation wheel X1 : Breath control X1 : Portamento time X1 : Data entry knob X1 : Foot volume : Sustain foot sw X1 : Portamento f sw : Data entry +1 X1 : Data entry -1
:Prog Change	: True #	: o 0 - 31 XXXXXXXXXXXXXXXX	: o 0 - 127 0 - 31	
:System Exclusive		: o	X2 : o	X2 : Voice parameters
:System	Song Pos Song Sel	: x x	: x x	
:Common	Tune	: x	: x	
:System	Clock	: x	: x	
:Real Time	Commands	: x	: x	
:Aux	Local ON/OFF	: x	: x	
	All Notes OFF		: o (123, 126, 127)	
:Mes-	Active Sense	: o	: o	
:sages	Reset	: x	: x	
Notes: All MIDI communications are enabled if MIDI switch is on.				
X1 = transmit/receive if CH information switch is on.				
X2 = transmit/receive if system information switch is on.				

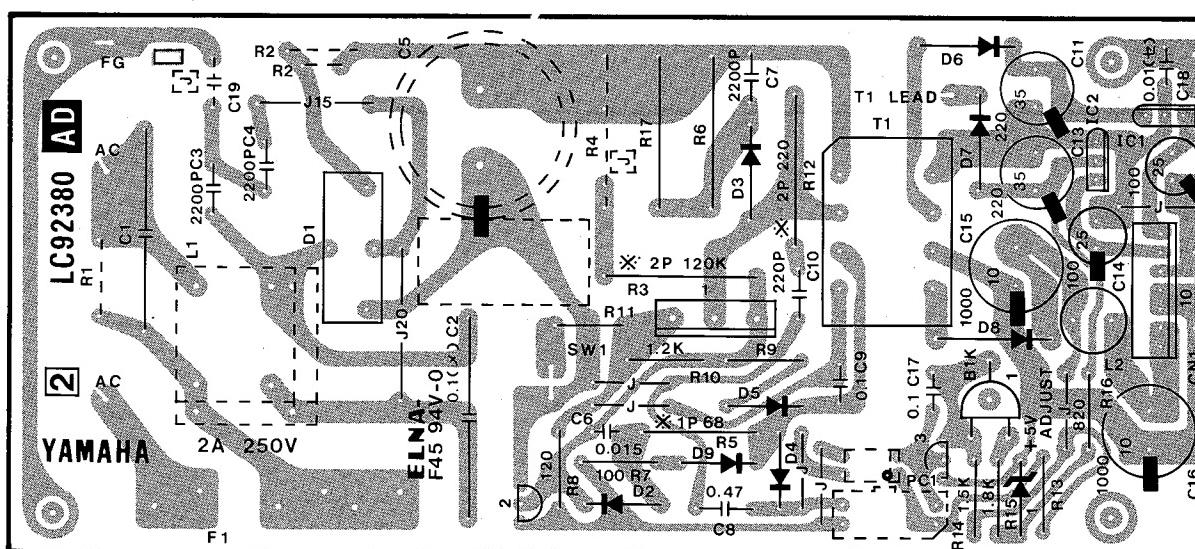
## ■ CIRCUIT BOARDS

- DM Circuit Board (NA814720)

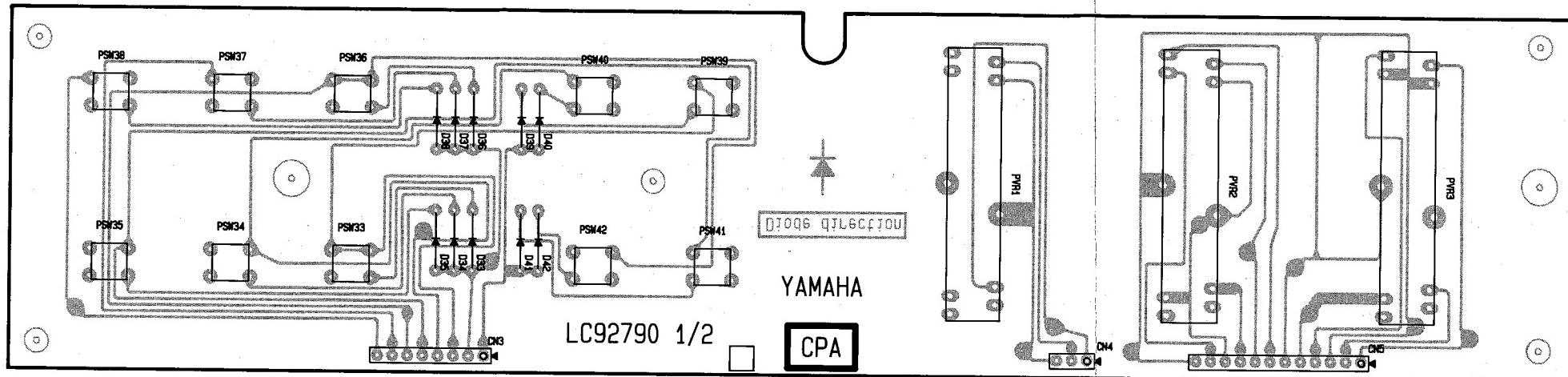


- AD Circuit Board
 

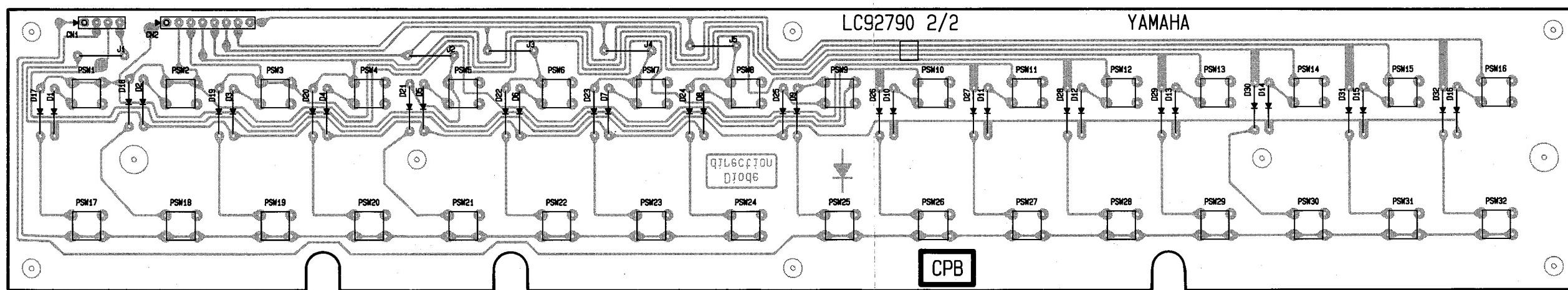
U.S. model.....	NA814340
Canadian model.....	NA814360
General model.....	NA814350
West Germany & Australian models.....	NA814810



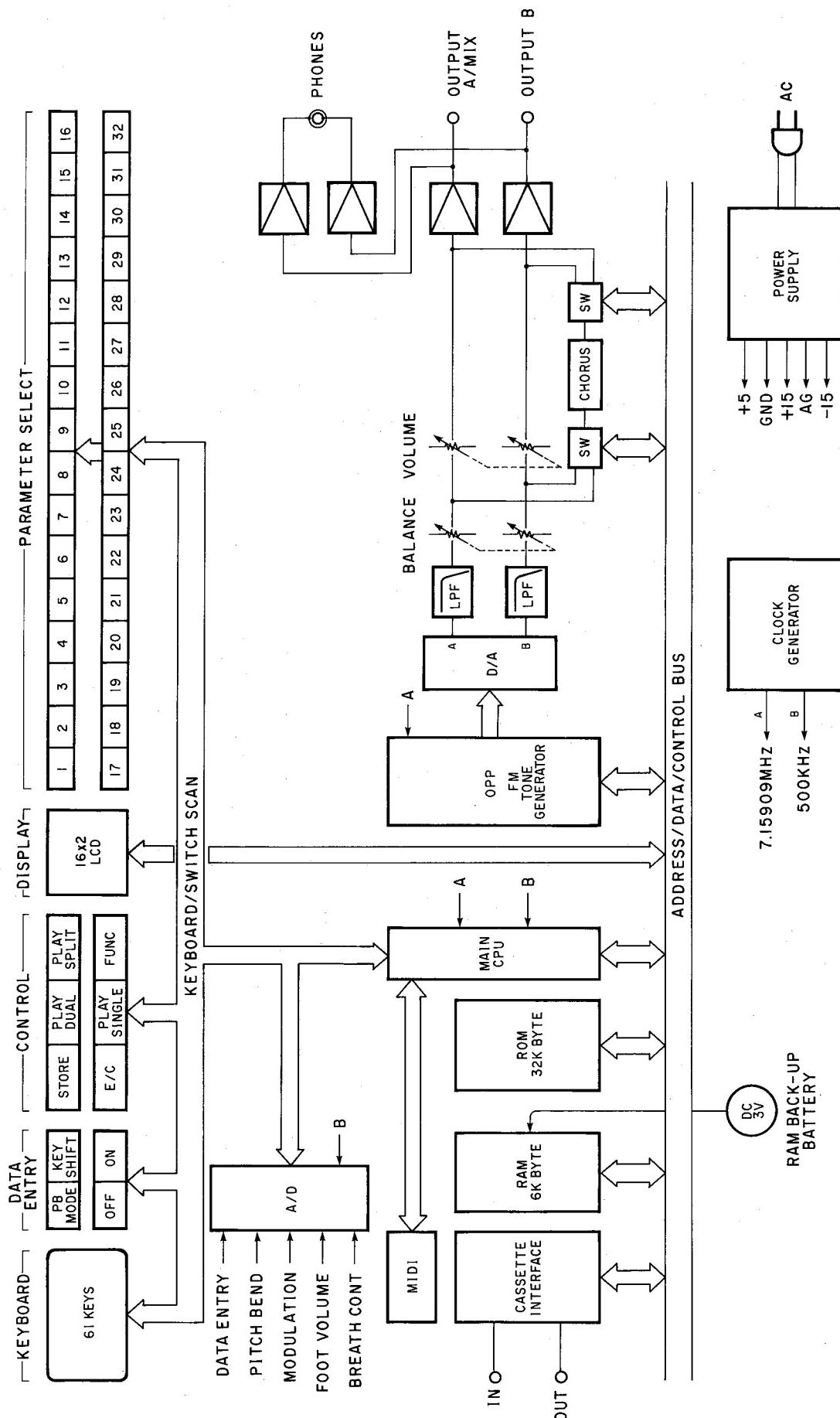
● PCA Circuit Board (NX801600)



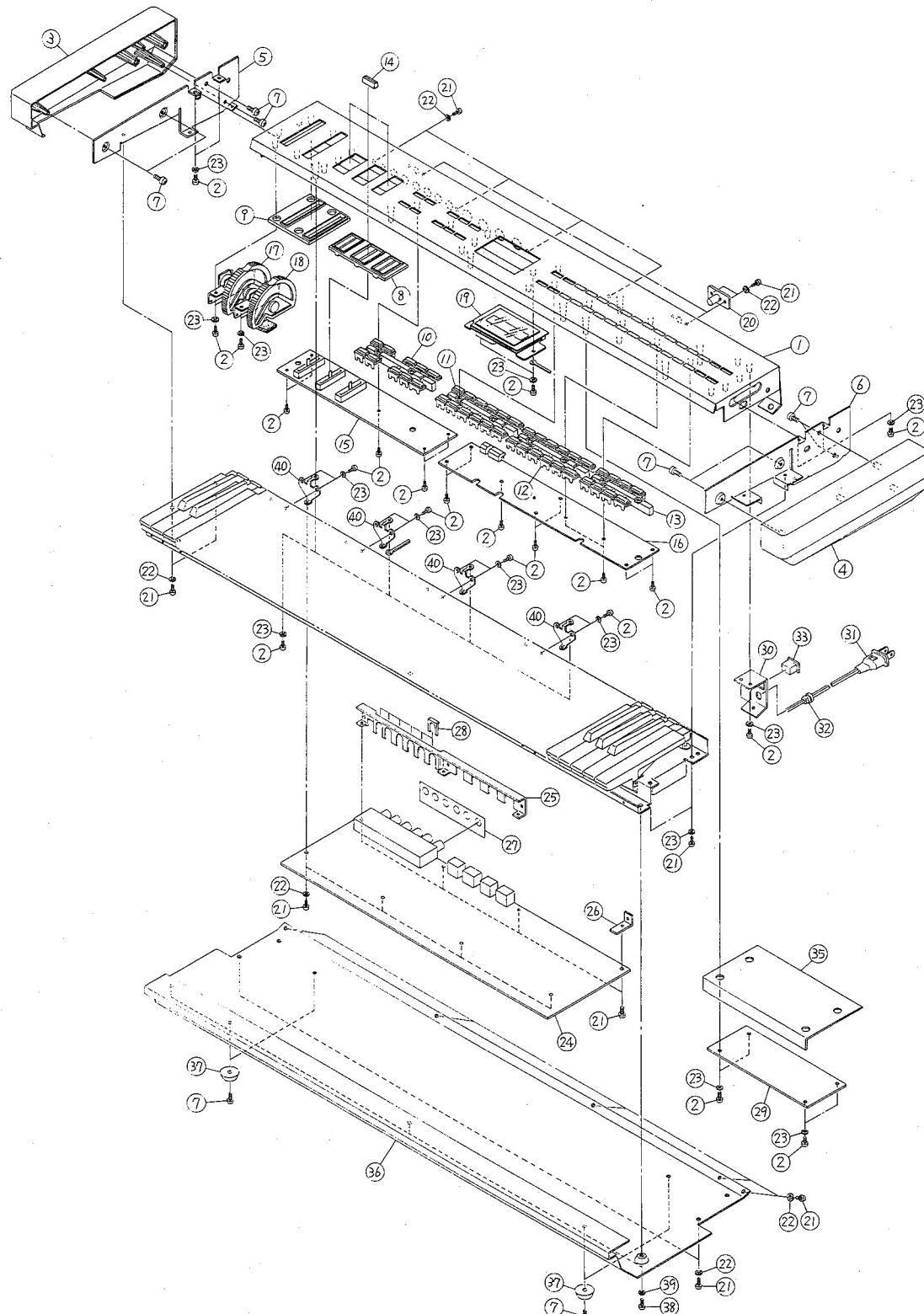
● PCB Circuit Board (NX801610)



## ■ BLOCK DIAGRAM



## ■ OVERALL ASSEMBLY



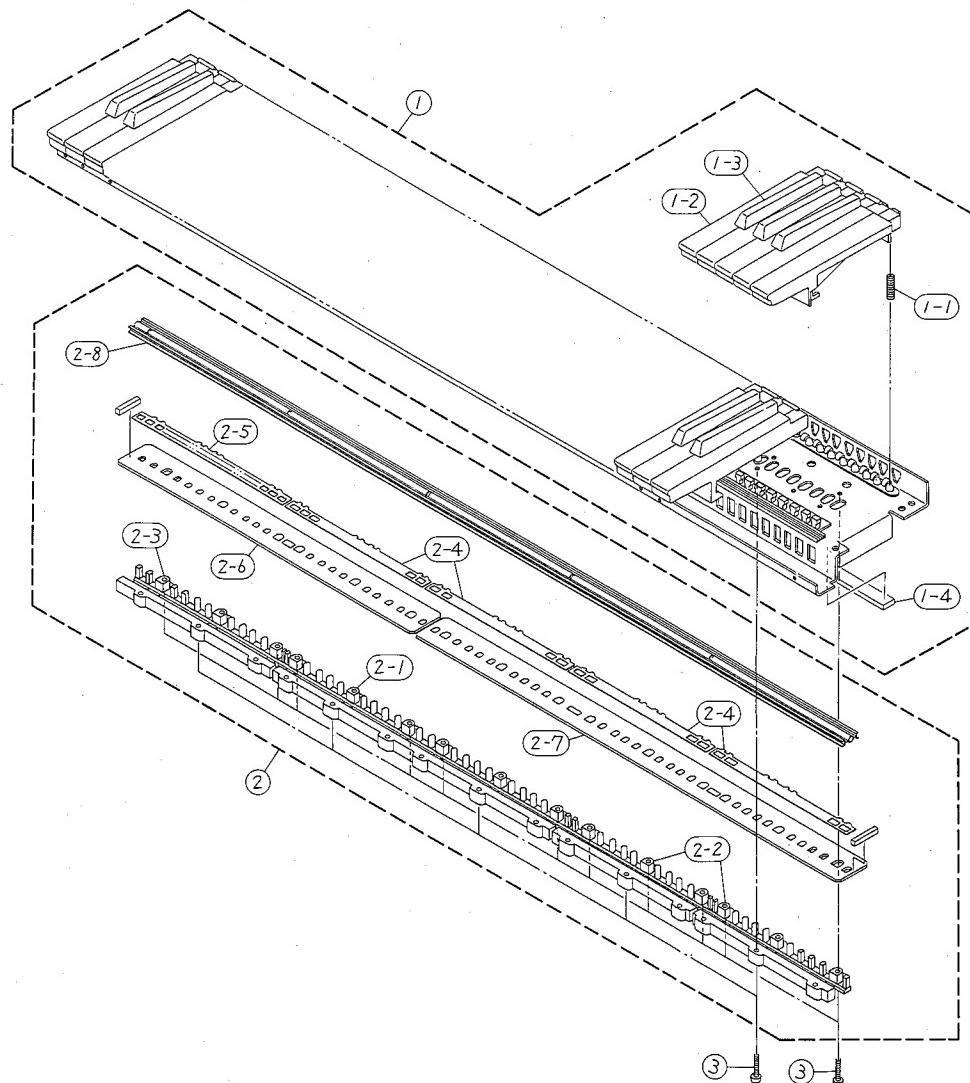
Ref. No.	Part No.	Description	部品名	Remarks	Common Model	Markets	ランク
*	1 AA 83 37 20	Control Panel	コントロールパネル				
*	2 ED 33 00 66	Bind Head Screw	M3×6 BI	バインド小ネジ			
*	3 CB 83 62 20	Side Cover	Left	側板			
*	4 CB 83 62 30	"	Right	"			
*	5 AA 83 38 10	Side Panel	Left	サイドパネル			
*	6 AA 83 38 20	"	Right				
7	Ei 34 01 06	Bind Head Screw	M4×10 BI	バインド小ネジ			

\* New Parts (新規部品)

Ref. No.	Part No.	Description		部品名	Remarks	Common Model	Markets	ランク
※ 8	CB 83 69 30	Escutcheon, Slide Potentiometer		スライドVRエスカッショ				
※ 9	CB 83 63 00	Escutcheon, Wheel		ホイールエスカッショ				
※ 10	CB 83 62 40	Push Button A		プッシュボタンA				
※ 11	CB 83 62 50	" B		" B				
※ 12	CB 83 62 60	" C		" C				
※ 13	CB 83 62 70	" D		" D				
14	CB 82 81 40	Knob		ツマミ				
※ 15	NX 80 16 00	PCA Circuit Board		P C A シート	Refer to Page 24			
※ 16	NX 80 16 10	PCB Circuit Board		P C B シート	"			
※ 17	NB 83 31 20	Wheel Assembly	PITCH	ホイールAss'y	Refer to Page 22			
※ 18	NB 83 31 30	"	MODULATION	"	"			
※ 19	NB 83 31 10	LCD Assembly		L C D Ass'y	"			
※ 20	CB 83 62 80	Bush, Music Rest		譜面板ブッシュ				
21	ED 34 00 86	Bind Head Screw	M4×8 BI	バインド小ネジ				
22	EV 41 30 46	Toothed Lock Washer	A4S BI	歯付座金				
23	EV 41 30 36	"	A3S BI	"				
※ 24	NA 81 47 20	DM Circuit Board	#92780	D M シート	Refer to Page 23			
※ 25	AA 83 38 30	Angle, Jack		J K アングル				
※ 26	AA 83 38 40	" , Circuit Board		シートアングル				
※ 27	CB 83 72 30	Ground Film		アースフィルム				
28	LB 30 19 10	Metal Fittings	U-type	U字金具				
29	NA 81 43 30	AD Circuit Board	#92380	A D シート	Refer to Page 24	J		
" NA 81 43 40	"	"	"	"	"	U		
" NA 81 43 60	"	"	"	"	"	C		
" NA 81 43 50	"	"	"	"	"	G		
" NA 81 48 10	"	"	"	"	"	WG,A		
※ 30	AA 83 37 40	AC Panel		A C パネル		J		
" AA 83 37 50	"			"	"	U		
" AA 83 37 60	"			"	"	C		
" AA 83 37 70	"			"	"	G,WG,A		
31	MG 00 06 00	Power Cord	7A 2.8m	電源コード		J		
" MG 00 01 00	"			"	"	U		
" MG 00 02 70	"			"	"	C		
" MG 00 08 60	"		2m	"	"	G		
" MG 00 04 50	"		3.5m	"	"	WG		
" MG 00 13 00	"			"	"	A		
32	CB 06 86 30	Cord Stopper	SR-SP-4	コードストッパー		J		
" CB 81 12 30	"	SR-6N-4		"	"	U		
" CB 80 68 50	"	SR-6N3-4		"	"	C		
" CB 07 27 50	"	SR-4N-4		"	"	G		
" CB 03 28 40	"	SR-5N-4		"	"	WG,A		
※ 33	KA 10 11 20	Seesaw Switch		シーソースイッチ	POWER			
34	ED 34 00 86	Bind Head Screw	M4×8 BI	バインド小ネジ		C,WG,A		
※ 35	CB 83 73 10	Insulation Sheet		絶縁シート				
※ 36	AA 83 37 30	Bottom Cover		底板				
37	CB 82 77 80	Foot		脚				
38	ED 35 01 06	Bind Head Screw	M5×10 BI	バインド小ネジ				
39	EV 41 00 50	Toothed Lock Washer	A5S	歯付座金				
※ 40	AA 83 38 00	Angle, Circuit Board		シートアングル				
※ VA 12 06 00	Instruction Tape			磁気テープ(商品説明)	Accessory	J		
※ VA 12 07 00	"			"	"	U,C,G, WG,A		
VA 11 35 00	Cassette Cable			カセットケーブル	"			
NB 82 63 60	Music Rest			譜面板	"			

※New Parts (新規部品)

## ■ KEYBOARD ASSEMBLY

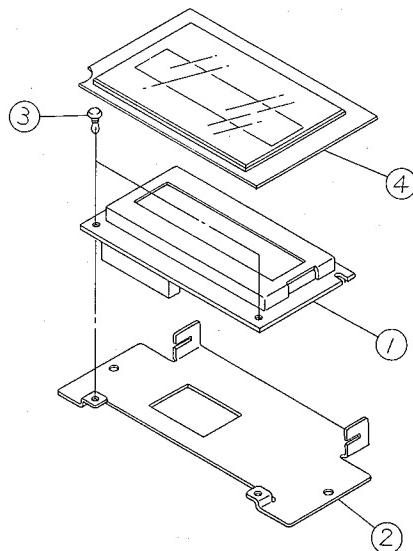


Ref. No.	Part No.	Description	部品名	Remarks	Common Model	Markets	ランク
1	NX 80 15 90	Frame Assembly	フレームAss'y				
1-1	AA 04 37 20	Coil Spring	コイルスプリング				
1-2	CB 03 22 10	White Key	C,F 白鍵				
"	CB 03 22 20	"	D	"			
"	CB 03 22 30	"	B,E	"			
"	CB 03 32 40	"	G	"			
"	CB 03 22 50	"	A	"			
"	CB 03 22 60	"	C	"			
1-3	CB 03 22 70	Black Key	黒鍵				
1-4	CC 02 17 60	Felt	フェルト				
2	NB 11 03 60	Switch Unit	スイッチユニット				
2-1	CB 04 63 30	Holder, Circuit Board	24 Keys	基板ホルダー			
2-2	CB 03 24 00	"	12 Keys	"			
2-3	CB 03 24 10	"	13 Keys	"			
2-4	CB 03 35 70	Spacer	絶縁スペーサー				
2-5	CB 03 35 80	"	"				
2-6	NA 11 08 50	MK1 Circuit Board	M K 1 シート	Refer to Page 24			
2-7	NA 11 11 40	MK3 Circuit Board	M K 3 シート	"			
2-8	CB 82 86 30	Rubber Contact	可動導電ゴム				
3	ED 33 01 46	Bind Head Screw	M3×14 BI	バインド小ネジ			

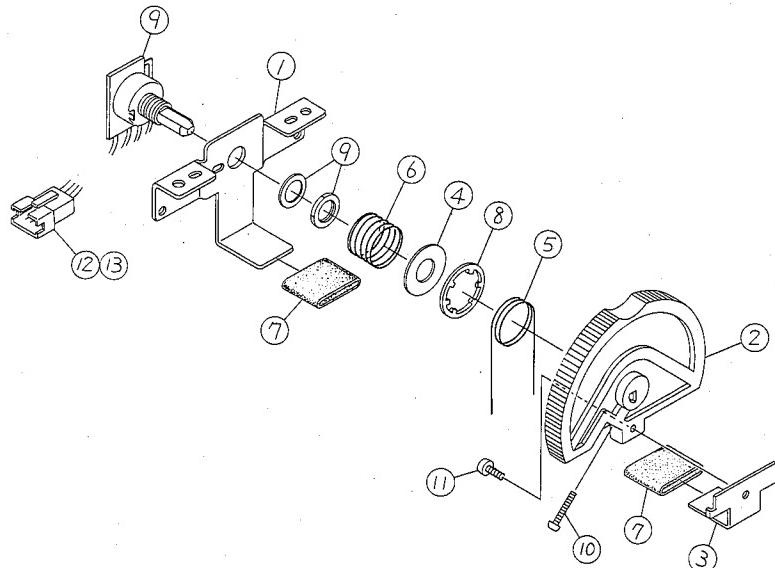
※New Parts (新規部品)

## ■LCD ASSEMBLY & WHEEL ASSEMBLY

### ●LCD ASSEMBLY



### ●WHEEL ASSEMBLY



Ref. No.	Part No.	Description	部品名	Remarks	Common Model	Markets	ランク
※	NB 83 31 10	LCD Assembly	L C D Ass'y				
※	1 NA 81 147 40	LCD Circuit Board	L C D シート	Refer to Page 24			
※	2 AA 83 37 90	Flame	L C D フレーム				
※	3 CB 83 56 50	Plastic Rivet	プラスチックリベット				
※	4 CB 83 62 90	Protector	L C D 保護板				
※	NB 83 31 20	Wheel Assembly	ホイールAss'y	PITCH			
※	NB 83 31 30	"	"	MODULATION			
※	1 AA 83 37 80	Frame	フレーム				
※	2 CB 82 82 81	Wheel	ホイール				
※	3 AA 81 74 70	Wheel Angle	ホイールアングル	PITCH			
4	AA 81 74 80	Wheel Plate	ホイールプレート	"			
5	AA 81 74 90	Return Spring	リターンスプリング	"			
6	AA 81 75 00	Friction Spring	フリクションスプリング	"			
7	CB 81 90 20	Wheel Tube	ホイールチューブ				
8	EK 80 12 60	Wheel Ring	C S 型 止め 輪	PITCH			
9	HS 31 24 60	Rotary Potentiometer	B10kΩ	ロータリーバリューム	"		
"	HS 41 21 60	"	"	"	MODULATION		
10	ED 33 01 66	Bind Head Screw	M3×16 BI	バインド小ネジ			
11	ED 33 00 86	"	M3×8 BI	"	PITCH		
12	LB 40 08 30	Connector Housing	4P	コネクタハウジング	"		
"	LB 30 11 90	"	3P	"	MODULATION		
13	BB 00 46 90	Contact Pin		コンタクトピン			

\*New Parts (新規部品)

## ■ CIRCUIT BOARDS &amp; ELECTRICAL PARTS

Ref. No.	Part No.	Description	部品名	Remarks	Common Model	Markets	ランク
*	NA 81 47 20	DM Circuit Board	# 92780	D M シート			
	FZ 00 41 10	Semiconductive Ceramic Cap.	0.1μF 16V	半導体セラコン			
	Fi 36 42 20	Electro Magnetic Interference	0.022μF 50V	エミフィル			
	FT 55 25 60	Polypropylene Cap.	560pF 50V	ポリプロコン			
	Hi 20 99 90	Carbon Composition Resistor	10MΩ	ソリッド抵抗			
	HU 57 71 00	Metal Film Resistor	10kΩ 1/4W	金属皮膜抵抗			
	HZ 00 31 90	Module Resistor	4.7kΩ×8	モジュール抵抗			
	GE 30 08 30	Ferite Core		フェライトコア			
	iA 09 33 00	Transistor	2SA933S (Q,R)	トランジスタ			
	iC 17 40 00	"	2SC1740S (R,S)	"			
	iC 28 78 00	"	2SC2878 (A,B)	"			
	iF 00 34 50	Diode	1SS133	ダイオード			
	iF 00 27 60	Zener Diode	05Z12A	ゼンナーダイオード			
	iG 10 09 00	IC	iG10090	I C	BBD Driver		
	iG 04 96 00	"	HD74LS14P	"	Hex Schmitt Trigger		
	iG 05 28 00	"	TC40H032OP	"	Quad 2 In OR		
*	iG 14 08 00	"	HD63B03XP	"			
	iG 05 10 00	"	TC40H004P	"	Hex Inverter		
	iG 05 11 00	"	TC40H074P	"	Dual D F-Flop		
	iG 11 19 00	"	TC40H138P	"	Decoder/Dempx		
	iG 07 86 00	"	TC40H374P	"	Octal D F-Flop		
	iG 00 16 90	"	TC4016BP	"	Quad Bilateral Sw		
	iG 00 17 20	"	TC4069UBP	"	Hex Inverter		
	iG 00 17 40	"	TC4050BP	"	Hex Buffer/Converter		
*	iG 11 62 00	"	PST518	"			
	iG 15 48 00	"	TA78L005AP	"	5V Regulator		
	iG 07 66 00	"	TL072CP	"	Operational Amp.		
	iG 00 13 90	"	NJM4558DV	"	Dual Operational Amp.		
	iG 10 62 00	"	M5M5118-15L	"	16K S RAM		
	iG 10 61 00	"	M58990P-1	"	10 bit ADC		
	iG 13 49 00	"	IR9311	"	Comparator		
	iG 05 66 00	"	NJM386D	"	Power Amp.		
	iG 12 06 00	"	MN3209	"	BBD 256K		
	iT 21 64 00	"	YM2164	"	OPP		
	iT 30 12 00	"	YM3012B	"	DAC		
	iG 15 50 20	"	256K Bit EPROM	"	# 1501～ IC2		
	iK 00 04 70	Photo Conductor	TLP552	フォトカプラー			
	QU 00 47 00	Ceramic Oscillator	500kHz	セラロック			
	QU 00 81 00	Quartz Crystal Unit	7.15909MHz	水晶振動子			
	PC 90 00 40	Lithium Battery, 3V	CR2032T	リチウム電池			
	LB 20 23 30	Phone Jack	Mono	ホーンジャック	MIX/A, SUSTAIN PORTAMENTO		
	LB 30 19 20	"	Stereo	"	VOLUME		
	LB 20 30 90	"	"	"	PHONES		
	LB 30 17 80	"	"	"	B		
	LB 30 20 10	Mini Jack		ミニジャック	BREATH		
	LB 60 37 10	DIN Jack	8P	D I N ジャック	CASSETTE		
	LB 50 05 20	"	5P	"	MIDI		
	LB 60 60 50	IC Socket	28P	I C ソケット			
	LB 91 80 70	Connector Base Pin	7P	コネクタベースピン	XH		
	LB 91 81 00	"	10P	"	"		
	LB 91 81 20	"	12P	"	"		
	LB 91 81 40	"	14P	"	XH		
	LB 93 50 40	Connector Housing	7P	コネクタハウジング			

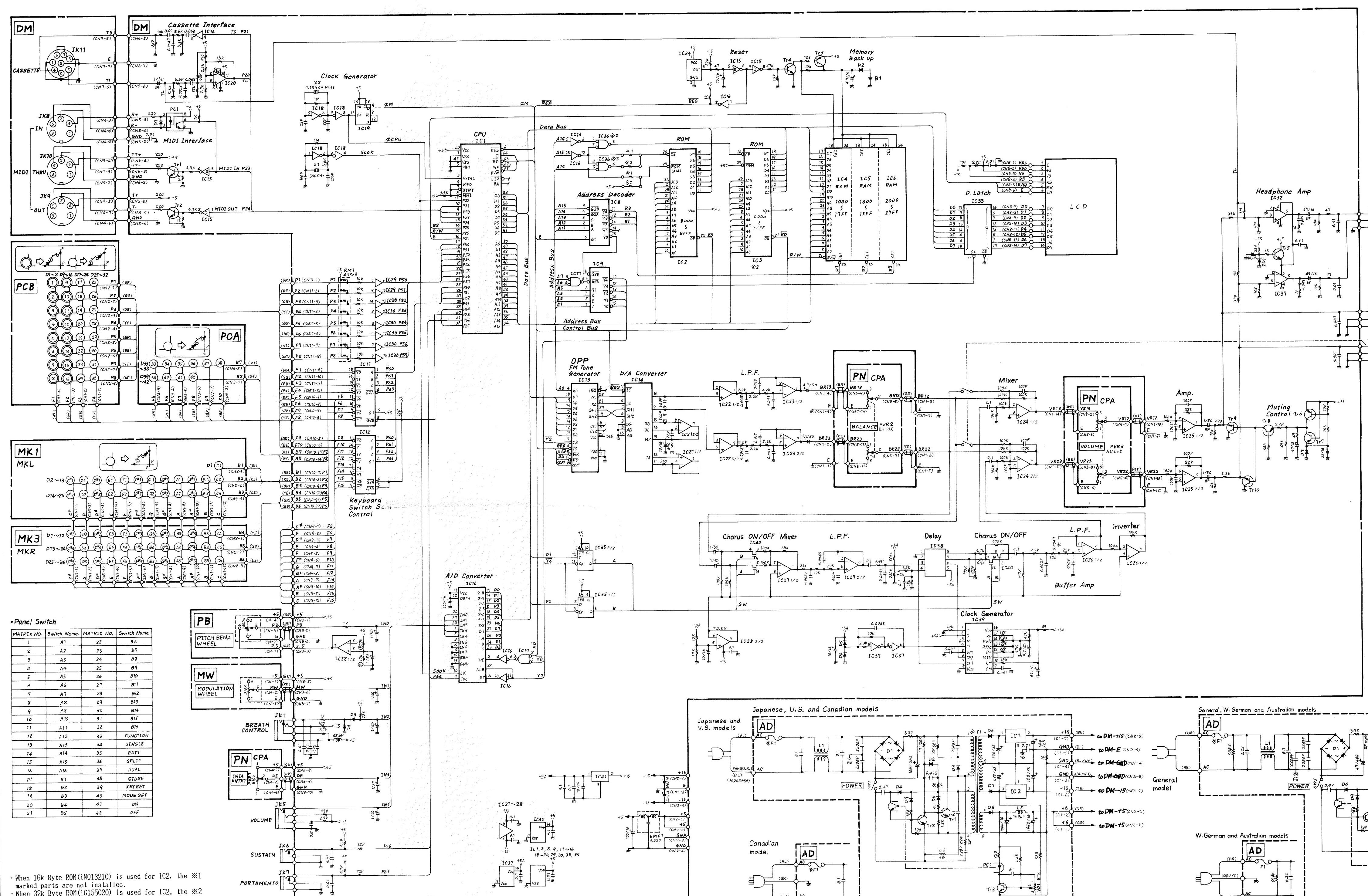
※New Parts (新規部品)

Ref. No.	Part No.	Description		部品名	Remarks	Common Model	Markets	ランク
	BB 00 57 70	Contact Pin		コントクトピン				
*	NX 80 16 00	PCA Circuit Board		PCAシート				
*	NX 80 16 10	PCB Circuit Board		PCBシート				
	HQ 23 01 80	Slide Potentiometer	B10kΩ	スライドVR	DATA ENTRY			
	HQ 23 02 30	"	BH10kΩ	"	BALANCE			
	HQ 23 02 20	"	A10kΩ×2	"	VOLUME			
	iF 00 00 40	Diode	1S1555	ダイオード				
	KA 90 70 30	Push Switch		プッシュスイッチ				
	LB 30 09 60	Connector Base Pin	3P	コネクタベースピン	NH			
	LB 40 06 30	"	4P	"	"			
	LB 60 30 10	"	8P	"	"			
	LB 60 31 50	"	12P	"	"			
*	NA 81 47 40	LCD Circuit Board		LCDシート				
	JN 20 00 90	LCD Module	16×2	LCDモジュール				
	LB 91 81 40	Connector Base Pin	14P	コネクタベースピン	XH			
	NA 11 08 50	MK1 Circuit Board		MK1シート	MKL			
	iF 00 34 50	Diode	1SS133	ダイオード				
	LB 92 31 20	Connector Base Pin	12P	コネクタベースピン				
	LB 91 60 30	"	3P	"				
	NA 11 11 40	MK3 Circuit Board	#32350	MK3シート	MKR			
	iF 00 34 50	Diode	1SS133	ダイオード				
	LB 92 31 20	Connector Base Pin	12P	コネクタベースピン				
	LB 91 60 40	"	4P	"				
	NA 81 43 30	AD Circuit Board	#92380	ADシート		J		
	NA 81 43 40	"	"	"		U		
	NA 81 43 60	"	"	"		C		
	NA 81 43 50	"	"	"		G		
	NA 81 48 10	"	"	"		WG,A		
C1	FR 20 31 00	Metallized Mylar Cap.	0.1μF	MMコン		J,U,C		
"	FR 20 32 20	"	0.22μF	"		G,WG,A		
C2	FR 20 31 00	"	0.1μF	"				
C5	FZ 00 68 80	Electrolytic Cap.	100μF 200V	アルミニウム電解コン		J,U,C		
"	FZ 00 68 90	"	47μF 400V	"		G,WG		
C11,13	FZ 00 74 80	"	220μF 35V	"				
C12,14	FZ 00 74 40	"	100μF 25V	"				
C15,16	FZ 00 68 60	"	1000μF 10V	"				
R3	HL 32 81 20	Metal Oxide Film Resistor	120kΩ 2W	酸化金属皮膜抵抗				
R4,6	HL 32 81 20	"	"	"		J,WG,A		
R5	HL 31 46 80	"	68Ω 1W	"				
R6	HL 32 76 80	"	68kΩ 2W	"		J,U,C		
R12	HL 32 52 20	"	220Ω 2W	"		"		
R17	HL 32 81 20	"	120kΩ 2W	"		G,WG,A		
R2	HZ 00 48 50	Wire Wound Resistor	10Ω 3W	セメント抵抗		J,U		
"	HZ 00 48 40	Thermo Fusing Resistor	10Ω 2W	抵抗温度ヒューズ		C		
"	HZ 00 48 60	Wire Wound Resistor	22Ω 3W	セメント抵抗		G,WG,A		
R11	HZ 00 48 70	"	2.2Ω 3W	"		J,U,C		
"	HZ 00 48 80	"	4.7Ω 3W	"		G,WG,A		
Tr1	iC 25 55 00	Transistor	2SC2555	トランジスタ		J,U,C		

※New Parts (新規部品)

#### ※ New Parts (新規部品)

# DX21 OVERALL CIRCUIT DIAGRAM



Notes:  
 - DM Circuit Board  
 IC1 : IUE6203XP (IG10800)  
 IC2 : 16k BYTE ROM (IG103210)  
 IC3 : 32k BYTE ROM (IG155020)  
 IC4 : 16k BYTES (IG103210)  
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